FORM PTO-1390 (Modified) (REV 11-98) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE

TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371

ATTORNEY'S DOCKET NUMBER	U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)
112740-164	09/786608

INTERNATIONAL APPLICATION NO.	INTERNATIONAL FILING DATE	PRIORITY DATE CLAIMED
PCT/DE99/02805	03 September 1999	03 September 1998

TITLE OF INVENTION

METHOD AND RADIO COMMUNICATION SYSTEM FOR SYNCHRONIZING SUBSCRIBER STATIONS

APPLICANT(S) FOR DO/EO/US

Michael Benz et al.

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☒ This is an express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT Articles 22 and 39(1).
4. ☒ A proper Demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
5. ☒ A copy of the International Application as filed (35 U.S.C. 371 (c) (2))
   a. ☐ is transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☒ has been transmitted by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
7. ☒ A copy of the International Search Report (PCT/ISA/210).
8. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371 (c)(3))
   a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
   b. ☐ have been transmitted by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
9. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
10. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371 (c)(4)).
11. ☒ A copy of the International Preliminary Examination Report (PCT/IPEA/409).
12. ☐ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371 (c)(5)).

Items 13 to 20 below concern document(s) or information included:

13. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
14. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
15. ☒ A **FIRST** preliminary amendment.
16. ☐ A **SECOND** or **SUBSEQUENT** preliminary amendment.
17. ☐ A substitute specification.
18. ☐ A change of power of attorney and/or address letter.
19. ☒ Certificate of Mailing by Express Mail
20. ☒ Other items or information:

Submission of Drawings - Figures 1-5 on four sheets

U.S. APPLICATION NO. (IF KNOWN, SEE 37 CFR)	INTERNATIONAL APPLICATION NO.	ATTORNEY'S DOCKET NUMBER
09/786608	PCT/DE99/02805	112740-164

21. The following fees are submitted:.

BASIC NATIONAL FEE (37 CFR 1.492 (a) (1) - (5)) :		CALCULATIONS	PTO USE ONLY
☐ Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2) paid to USPTO and International Search Report not prepared by the EPO or JPO	$1,000.00		
☒ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but Internation Search Report prepared by the EPO or JPO	$860.00		
☐ International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO	$710.00		
☐ International preliminary examination fee paid to USPTO (37 CFR 1 482) but all claims did not satisfy provisions of PCT Article 33(1)-(4)	$690.00		
☐ International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(1)-(4)	$100.00		
ENTER APPROPRIATE BASIC FEE AMOUNT =		$860.00	
Surcharge of **$130.00** for furnishing the oath or declaration later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (e)).		$0.00	

CLAIMS	NUMBER FILED	NUMBER EXTRA	RATE		
Total claims	13 - 20 =	0	x $18.00	$0.00	
Independent claims	2 - 3 =	0	x	$0.00	
Multiple Dependent Claims **(check if applicable)** .			☐	$0.00	
TOTAL OF ABOVE CALCULATIONS			=	$860.00	
Reduction of 1/2 for filing by small entity, if applicable. Verified Small Entity Statement must also be filed (Note 37 CFR 1.9, 1.27, 1.28) **(check if applicable)** .			☐	$0.00	
SUBTOTAL			=	$860.00	
Processing fee of **$130.00** for furnishing the English translation later than ☐ 20 ☐ 30 months from the earliest claimed priority date (37 CFR 1.492 (f)).			+	$0.00	
TOTAL NATIONAL FEE			=	$860.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31) **(check if applicable).**			☐	$0.00	
TOTAL FEES ENCLOSED			=	$860.00	
				Amount to be: refunded	$
				charged	$

☒ A check in the amount of **$860.00** to cover the above fees is enclosed.

☐ Please charge my Deposit Account No. in the amount of to cover the above fees.
A duplicate copy of this sheet is enclosed.

☒ The Commissioner is hereby authorized to charge any fees which may be required, or credit any overpayment to Deposit Account No. **02-1818** A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO.

William E. Vaughan
Bell, Boyd & Lloyd LLC
P.O. Box 1135
Chicago, IL 60690-1135

SIGNATURE

William E. Vaughan
NAME

39,056
REGISTRATION NUMBER

March 5, 2001
DATE

BOX PCT

IN THE UNITED STATES ELECTED/DESIGNATED OFFICE
OF THE UNITED STATES PATENT AND TRADEMARK OFFICE
UNDER THE PATENT COOPERATION TREATY-CHAPTER II

PRELIMINARY AMENDMENT

APPLICANTS:	Michael Benz et al.	DOCKET NO: 112740-164
SERIAL NO:		GROUP ART UNIT:
		EXAMINER:
INTERNATIONAL APPLICATION NO:		PCT/DE99/02805
INTERNATIONAL FILING DATE:		03 September 1999
INVENTION:	METHOD AND RADIO COMMUNICATION SYSTEM FOR SYNCHRONIZING SUBSCRIBER STATIONS	

Assistant Commissioner for Patents,
Washington, D.C. 20231

Sir:

Please amend the above-identified International Application before entry into the National stage before the U.S. Patent and Trademark Office under 35 U.S.C. §371 as follows:

In The Specification:

On page 1, cancel lines 1-4 and substitute the following therefor:

--S P E C I F I C A T I O N

TITLE

METHOD AND RADIO COMMUNICATION SYSTEM FOR SYNCHRONIZING SUBSCRIBER STATIONS

BACKGROUND OF THE INVENTION

Field of the Invention--.

On page 1, line 6, insert --present-- before "invention".

On page 1, line 8, cancel "especially" and substitute therefor --particularly--

.

On page 1, line 9, cancel "comprising" and substitute therefor --which includes--.

On page 1, before line 11, insert the following left-hand justified heading: --**Description of the Prior Art**--.

On page 1, line 12, insert a --,-- after "example".

On page 1, line 26, cancel the "," and substitute therefor a --;--.

On page 2, line 6, cancel "can".

On page 2, line 6, insert --can-- after "also".

On page 2, line 8, cancel "according to figure" and substitute therefor --as shown in Figure--.

On page 2, line 14, cancel the "," and substitute therefor a --;--.

On page 2, line 14, cancel "figure" and substitute therefor --Figure--.

On page 2, line 17, cancel "the" before "object" and substitute therefor --an--.

On page 2, line 17, insert --present-- before "invention".

On page 2, lines 18-19, cancel "by means of" and substitute therefor --via--.

On page 2, line 21, cancel "This object is".

On page 2, cancel lines 22-25.

On page 2, before line 26, insert the following centered heading:

--**SUMMARY OF THE INVENTION**--.

On page 2, line 26, insert --present-- before "invention".

On page 2, line 26, insert --therefore,-- after the ",".

On page 3, line 7, cancel "by means of" and substitute therefor --via--.

On page 3, line 12, cancel "for example".

On page 3, line 15, insert --, for example,-- after "sequences".

On page 3, line 20, insert a --,-- after "examples".

On page 3, line 21, insert a --,-- after "codes".

On page 3, line 22, cancel "an advantageous" and substitute therefor --another--.

On page 3, line 23, insert --present-- before "invention".

On page 3, line 28, cancel "can".

On page 3, line 28, insert --can-- after "also".

On page 3, line 29, insert a --,-- after "is".

On page 3, line 29, insert a --,-- after "thus".

On page 3, line 30, cancel "can".

On page 3, line 30, insert --can-- after "also".

On page 4, line 33, insert --easily-- after "drawback".

On page 4, line 33, cancel "easily".

On page 4, cancel lines 35-37 and substitute the following paragraph therefor:

--Additional features and advantages of the present invention are described in, and will be apparent from, the following Detailed Description of the Preferred Embodiments and the Drawings.--

On page 5, before line 1, insert the following centered heading:

--**DESCRIPTION OF THE DRAWINGS**--.

On page 5, line 2, cancel "the" and substitute therefor --a--.

On page 5, line 2, cancel the "," and substitute therefor --in a radio communication system;--.

On page 5, line 4, insert --a-- after "between".

On page 5, line 5, cancel the "," and substitute therefor --in a radio communication system of the present invention;--.

On page 5, line 8, cancel the "," and substitute therefor --in accordance with the teachings of the present invention;--.

On page 5, line 9, cancel the "," and substitute therefor --for transmitting control information;--.

On page 5, line 11, insert --of subscriber stations-- after "synchronization".

On page 5, before line 13, insert the following centered heading:

--**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS**--.

On page 5, line 33, cancel "by means of" and substitute therefor --via--.

On page 6, line 18, cancel "figure" and substitute therefor --Figure--.

On page 7, line 5, insert --present-- before "invention".

On page 7, line 31, cancel "In consequence" and substitute therefor --As a result--.

On page 8, line 5, cancel "figure" and substitute therefor --Figure--.

On page 8, line 15, cancel "figure" and substitute therefor --Figure--.

On page 8, line 17, cancel "by means of" and substitute therefor --via--.

On page 8, line 18, insert --also-- after "information".

On page 8, line 19, cancel "also".

On page 8, line 32, cancel "can".

On page 8, line 32, insert --can-- after "also".

On page 9, line 9, cancel "can".

On page 9, line 9, insert --can-- after "also".

On page 9, line 10, cancel "is".

On page 9, line 10, insert --is-- after "also'.

On page 9, line 11, cancel "by means of" and substitute therefor --via--.

On page 9, line 14, cancel the "," and substitute therefor a --;--.

On page 9, line 14, insert a --,-- after "example".

On page 9, line 23, insert --as shown in Figure 5-- before the ".

On page 9, line 30, cancel "by means of" and substitute therefor --via--.

On page 9, line 36, cancel "is".

On page 9, line 36, insert --is-- after "also".

On page 10, after line 2, insert the following paragraph:

--Although the present invention has been described with reference to specific embodiments, those of skill in the art will recognize that changes may be made thereto without departing from the spirit and scope of the invention as set forth in the hereafter appended claims.--

After page 14, cancel lines 1-4, and substitute the following centered heading therefor:

--**ABSTRACT OF THE DISCLOSURE**--.

On page 14, line 6, cancel "According to the invention," and substitute therefor --A method and radio communication system for synchronizing subscriber stations, wherein--.

On page 14, line 21, cancel "by means of" and substitute therefor --via--.

On page 14, cancel line 27.

In the Claims:

On page 11, cancel line 1, and substitute the following left-hand justified heading therefor:

--**We Claim As Our Invention:**--.

Please cancel claims 1-13, without prejudice, and substitute the following claims therefor:

14. A method for synchronizing subscriber stations in a radio communication system, the method comprising the steps of:

allocating a time slot for transmitting at least one synchronization sequence to a number of base stations;

allocating to adjacent base stations a different time offset with respect to a beginning of the time slot for transmitting the at least one synchronization sequence, wherein the time offset corresponds to at least one of a choice of at least one synchronization sequence and a sequence of a number of synchronization sequences;

receiving, at a subscriber station, the synchronization sequence; and

performing, via the subscriber station, a time synchronization via both a time of reception of the synchronization sequence and at least one of the detected synchronization sequence designating the time offset and the detected sequence of the number of synchronization sequences.

15. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 14, further comprising the step of:

transmitting two synchronization sequences in one time slot.

16. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 15, further comprising the step of:

predetermining a time gap between the two synchronization sequences in the one time slot.

17. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 14, the method further comprising the step of:

transmitting further information by the base station by a choice of at least one of the synchronization sequences and the sequence of a number of synchronization sequences.

18. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 17, wherein the further information relates to at least one of a frame synchronization, midambles, and spread-spectrum codes used by the base station.

19. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 17, wherein the further information relates to information on the configuration of a control channel.

20. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 19, wherein the information on configuration relates to at least one of a variable number of time slots and spread spectrum codes.

21. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 17, wherein the coding of the further information extends over a number of time slots due to at least one of the choice of synchronization sequences and the sequence of synchronization sequences.

22. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 14, wherein the synchronization sequences are unmodulated orthogonal gold codes.

23. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 14, wherein the time slots are a part of a TDD transmission arrangement with broadband channels, a number of time slots per frame being used for the synchronization.

24. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 14, wherein the synchronization sequences are transmitted in time slots in which information of a control channel is additionally transmitted.

25. A method for synchronizing subscriber stations in a radio communication system as claimed in claim 14, wherein the synchronization sequences are transmitted at lower power compared with other transmissions of the base station.

26. A radio communication system, comprising:

a plurality of base stations for transmitting at least one synchronization sequence;

a controller which assigns a time slot and a different time offset with respect to a beginning of the time slot for transmitting the synchronization sequence to

adjacent base stations, the time offset corresponding to at least one of a choice of at least one synchronization sequence and a sequence of a number of synchronization sequences;

a subscriber station for receiving and evaluating the synchronization sequence; and

a synchronization part allocated to the subscriber station which performs a time synchronization via a time of reception of the synchronization sequence and at least one of a detected synchronization sequence designating the time offset and a detected sequence of a number of synchronization sequences.

REMARKS

The present amendment makes editorial changes and corrects typographical errors in the specification in order to conform the specification to the requirements of the United States Patent practice. No new matter is added thereby. Original claims 1-13 have been canceled in favor of new claims 14-26. Claims 14-26 have been presented solely because the revisions by bracketing and underlining which would have been necessary in claims 1-13 in order to present those claims in accordance with preferred United States Patent practice would have been too extensive, and thus would have been too burdensome. The amendment is intended for clarification purposes only and not for substantial reasons related to patentability pursuant to 35 U.S.C. §§101, 102, 103 or 112. Indeed, the cancellation of claims 1-13 does not constitute an intent on the part of the Applicants to surrender any of the subject matter of claims 1-13.

Early consideration on the merits is respectfully requested.

Respectfully submitted,

(Reg. No. 39,056)

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4/PRTS

Description

Method and radio communication system for synchronizing subscriber stations

The invention relates to a method and a radio communication system for synchronizing subscriber stations, especially to the synchronization within a mobile radio system comprising broadband channels and TDD and CDMA subscriber separation.

In radio communication systems, messages (for example voice, video information or other data) are transmitted via an air interface with the aid of electromagnetic waves. The air interface relates to a connection between a base station and subscriber stations, where the subscriber stations can be mobile stations or stationary radio stations. The electromagnetic waves are radiated with carrier frequencies which are in the frequency band provided for the respective system. For future radio communication systems, for example the Universal Mobile Telecommunication System (UMTS) or other third-generation systems, frequencies within the frequency band of approx. 2000 MHz are provided.

For the third mobile radio generation, two modes are provided, one mode designating an FDD (Frequency Division Duplex) mode, see ETSI STC SMG2 UMTS-L1, Tdoc SMG2 UMTS-L1 221/98, of 25.8.1998, and the other mode designating a TDD (Time Division Duplex) mode, see DE 198 27 700. The operating modes are used in different frequency bands and both use time slots.

In ETSI STC SMG2 UMTS-L1, Tdoc SMG2 UMTS-L1 221/98, of 25.8.1998, a synchronization method which uses synchronization sequences transmitted in every time slot is described in chapters 2.3.3.2.3 and 6.3

for the FDD mode. This makes it possible to synchronize the subscriber stations at the beginning of the time slot. The sequence of transmissions of a second synchronization sequence signals which spread-spectrum code is used by the base station. Furthermore, the beginning of the frame can also be derived therefrom.

However, this synchronization method leads to a scenario according to figure 1 with a synchronous operation of the base stations. The synchronization sequences of base stations of two radio cells Z1, Z3 are superimposed at the receiving subscriber station since the transmissions of the synchronization sequences of all base stations are referred to at the beginning of a frame, see figure 10 in ETSI STC SMG2 UMTS-L1, Tdoc SMG2 UMTS-L1 221/98 of 25.8.1998. The superimposition impairs proper synchronization.

It is, therefore, the object of the invention to specify a method and a radio communication system by means of which the synchronization of the subscriber stations is possible without errors even with at least partially synchronized base stations. This object is achieved by the method having the features of claim 1 and the radio communication system having the features of claim 13. Advantageous further developments can be found in the subclaims.

According to the invention, a time slot for transmitting at least one synchronization sequence is allocated to a number of base stations, either by a higher-level entity or by own selection. Adjacent base stations use a different time offset with respect to the beginning of the time slot for transmitting the synchronization sequence. This precludes superposition even with a synchronized operation of the base stations.

The time offset is transmitted so that the subscriber station can still determine the beginning of the time slot. The time

offset corresponds to the choice of one or more synchronization sequences and/or the sequence of a number of synchronization sequences. In this manner, the information relating to the time offset is transmitted in coded form. A subscriber station receives the synchronization sequence and performs a time synchronization by means of the time of reception of the synchronization sequence and the detected synchronization sequence designating the time offset and/or the detected sequence of a number of synchronization sequences.

To signal the time offset, for example many variants of a single synchronization sequence and/or the order of transmission of different synchronization sequences can be used. Advantageously, two synchronization sequences are transmitted in one time slot as in the FDD mode described above. The first synchronization sequence is used for determining the time of reception and for coarse synchronization. The sequence of the second synchronization sequences over a number of transmissions codes the time offset.

According to an advantageous embodiment of the invention, a time interval between the two synchronization sequences in one time slot is predetermined. This provides the possibility of using a single, switchable filter for detecting both synchronization sequences. The second synchronization sequence can also be transmitted before the first one and the time interval is thus negative. If two different filters are used, the two sequences can also be transmitted simultaneously.

It is also advantageous to transmit further information by a choice of synchronization sequences and/or their sequence. This provides for quicker operational readiness of the subscriber stations. The further information relates to a frame synchronization, midambles used by the base station, spread-spectrum codes or information

on the configuration of a control channel. A high coding gain is achieved if the coding of the further information by choice and/or sequence of the synchronization sequences extends over a number of time slots. If, for example, 17 variants of the second synchronization sequence are used and the sequence of eight transmissions of the second synchronization sequence is evaluated, this provides 17^8 possibilities. Only a small proportion of these needs to be used.

The synchronization sequences are advantageously unmodulated orthogonal gold codes. As a result, the synchronization method of the FDD mode does not need to be modified much. The synchronization method is particularly suitable for radio communication systems in which the time slots are a part of a TDD transmission arrangement with broadband channels. In this arrangement, a number of time slots per frame can be used for the synchronization. Thus, parts of the detection device can be used for both modes in multi-mode subscriber stations.

To use the fewest possible system resources for broadcasting purposes, the synchronization sequences are sent in time slots in which information of a control channel is additionally transmitted. Thus, only a small number of time slots needs to be continuously kept available in the downlink direction (from the base station to the subscriber station). The degrees of freedom of the asymmetry of both directions of transmission are not much restricted. To keep the interference caused by the synchronization sequences in the remaining channels as low as possible, they are sent at a lower power compared with other transmissions of the base station. This drawback can be easily compensated for by the coding gain.

Exemplary embodiments of the invention will be explained in greater detail with reference to the attached drawings, in which

Figure 1 shows an example of superpositions of synchronization sequences at the receiver,

Figure 2 shows a diagrammatic representation of the air interface between base station and subscriber stations,

Figure 3 shows an arrangement for using a time offset in the transmission of the synchronization sequences,

Figure 4 shows different types of control channels, and

Figure 5 shows a flow chart for the synchronization.

The frame structure of the radio transmission can be seen in Figure 2. According to a TDMA (Time Division Multiple Access), a broadband frequency band, for example with a bandwidth B = 5 MHz, is divided into a number of time slots ts of the same duration, for example 16 time slots ts0 to ts15. A frequency band extends over a frequency range B. Some of the time slots are used in the downlink direction DL and some of the time slots are used in the uplink UL. As an example, an asymmetry ratio of 3:1 in favor of the downlink DL is shown. In this TDD transmission method, the frequency band for the uplink UL corresponds to the frequency band of the downlink DL. The same is repeated for other carrier frequencies. Due to the variable allocation of the time slots ts for the uplink or downlink, a great variety of asymmetric resource allocations can be made.

Within the time slots, the information from a number of connections is transmitted in message blocks. The data d are spread in a connection-oriented manner by means of a fine structure, a spread-spectrum code c so that at the receiving end, for example n connections can be separated by this CDMA (Code Division Multiple Access) component. The spreading of individual symbols of the data d has the effect that Q chips of duration

T_{chip} are transmitted within the symbol period T_{sym}. The Q chips here form the connection-oriented spread-spectrum code c.

Within a broadband frequency range B, the successive time slots ts are arranged in accordance with a frame structure. Thus, 16 time slots ts are combined to form one frame fr.

The parameters used for the air interface are advantageously:

Chip-rate:	4.096 Mcps
Frame period:	10 ms
Number of time slots:	16
Duration of a time slot:	625 µs
Spreading factor:	16
Type of modulation:	QPSK
Bandwidth:	5 MHz
Frequency reuse value:	1

These parameters provide for the best possible harmonization with an FDD (Frequency Division Duplex) mode for the 3rd mobile radio generation.

In the downlink according to figure 3, for example, two time slots ts0, ts8 are used for synchronization. Thus, two synchronization sequences cp, cs separated by a time gap t_{gap} are in each case transmitted in one time slot ts8. The separation of the two synchronization sequences cp, cs has the advantage of reduced interference since the noise power of both sequences is distributed better over time. The first synchronization sequence cp is the same in each time slot ts0, ts8. The second synchronization sequence cs can be chosen individually for each time slot ts0 to time slot ts8.

The choice and order of the second synchronization sequence cs corresponds to a time offset toff by which the transmission of the first synchronization sequence cp is delayed with respect to the beginning of time slot ts8. The receiving subscriber station MS can determine the time offset toff

by receiving and evaluating the synchronization sequences cs and take this into consideration during the synchronization.

Adjacent base stations BS are frame-synchronized. According to the invention, a different time offset toff for transmitting the synchronization sequences is assigned to adjacent base stations BS. For example, 32 different time offsets toff are used so that cell clusters can be formed and when the time offset toff is changed for one base station BS, the whole cluster does not need to be changed.

Due to the choice and sequence of the second synchronization sequences cs over, for example, 4 frames fr and two time slots ts0, ts8 per frame fr, 17^8 different possibilities for transmitting further information in addition to the time offset toff are created when 17 different unmodulated orthogonal cold codes of 256 chips length are used. Due to the many possibilities, the coding gain is high so that the synchronization sequences cp, cs can be transmitted at low power.

The further information relates to the frame synchronization, midambles used by the base station, spread-spectrum codes (the midambles and spread-spectrum codes being issued independently of one another) and information on the configuration of a control channel BCCH. In the case of two time slots ts per frame fr, used for the synchronization, the beginning of the frame is still inaccurate by a factor of two after detection of the synchronization in one time slot ts. In consequence, the frame synchronization can be produced easily by a certain sequence of second synchronization sequences cs. In addition, the later detection of information of the control channel BCCH is speeded up if midambles, spread-spectrum codes and information on the configuration are already transmitted during the synchronization.

In particular, there is the possibility of introducing a scalable control channel BCCH which is announced by the sequence of synchronization sequences cs independently of the use of the time offset toff. According to figure 4, for example, control information can be transmitted in one, two or four channels. Thus, the data rate of the control channel BCCH can be adapted to the cell-related requirements in accordance with the services offered there. This provides for future modification of the control channel BCCH. Thus, the parameters (number of channels, time slots and spread-spectrum codes) of the control channel BCCH do not need to be fixed in advance throughout the system but can be transmitted during the synchronization.

In addition to the variants of figure 4, it is also possible to inform about additional channels with control information by means of the further information from the synchronization. Thus, control information can also be temporarily transmitted in additional channels. The control channel BCCH is transmitted in parallel with other user data calls but possibly with greater error protection coding.

The transmissions of the control channel BCCH and of the synchronization sequences cp, cs are preferably located in the same time slot ts, as a result of which only two time slots ts0, ts8 need to be continuously reserved for the downlink DL. The adjustability of the asymmetry is only restricted very slightly.

If the asymmetry ratios in the system are such that more than two time slots ts0, ts8 are used for the downlink DL, control information can also be transmitted in the remaining time slots ts allocated to the down link DL. It is then also possible to transmit the control information exclusively in time slots ts in which the synchronization sequences cp, cs are not transmitted. The flexibility of the

control channel BCCH provides additional advantages since, for example, a distribution over a number of time slots results in greater robustness of the transmission with respect to interference.

Using a multicode transmission in the control channel BCCH (a number of spread-spectrum codes c per time slot ts) within a time slot ts provides for an adaptive increase in the data rate of the control channel BCCH. A similar effect can also be achieved by reducing the spreading factor which is also transmitted by means of the choice and sequence of the synchronization sequences cs. The choice of time slots ts for transmitting the control information can be coordinated by a higher-level entity, for example a radio network resource manager RNM for a number of base stations BS.

The assignment of time slots ts0, ts8 for the synchronization and of different time offsets toff with respect to the beginning of time slot ts0, ts8 for transmitting the synchronization sequences cp, cs, performed in a controller, e.g. the radio network resource manager RNM of a base station system, precedes the synchronization as a first step 1. In a second step 2, a number of base stations BS transmit the synchronization sequences cp, cs in the predetermined order which is particular to each base station and corresponds to the time offset toff.

In a third step 3, a subscriber station MS receives the synchronization sequences cp, cs and performs a coarse synchronization by means of the first synchronization sequence cp. Evaluation of the second synchronization sequences cs in a fourth step 4 enables the time slots to be synchronized to the beginning of time slot ts whereupon, in a fifth step 5, the frame synchronization and the preparation for reception of the control channel BCCH is also performed by evaluating the further information. Steps 3 to 5 are performed by synchronization means SYNC allocated to the subscriber station which,

for example, represent a signal processing processor and correlators formed by signal-adapted filters.

Patent Claims

1. A method for synchronizing subscriber stations (MS) in a radio communication system, in which a time slot (ts) for transmitting at least one synchronization sequence (cp, cs) is allocated to a number of base stations (BS),
adjacent base stations (BS) use a different time offset (toff) with respect to the beginning of the time slot (ts) for transmitting the synchronization sequence (cp, cs),
the time offset (toff) corresponds to the choice of one or more synchronization sequences (cp, cs) and/or to the sequence of a number of synchronization sequences (cp, cs),
a subscriber station (MS) receives the synchronization sequence (cp, cs),
the subscriber station (MS) performs a time synchronization by means of the time of reception of the synchronization sequence (cp, cs) and the detected synchronization sequence (cp, cs) designating the time offset (toff) and/or the detected sequence of a number of synchronization sequences (cp, cs).

2. The method as claimed in claim 1, characterized in that two synchronization sequences (cp, cs) are transmitted in one time slot (ts).

3. The method as claimed in claim 2, characterized in that a time gap (t_{gap}) is predetermined between the two synchronization sequences (cp, cs) in a time slot (ts).

4. The method as claimed in one of the preceding claims, characterized in that further information is transmitted by the base station (BS) by a choice of synchronization sequences (cp, cs) and/or their sequence.

5. The method as claimed in claim 4 characterized in that

the further information relates to a frame synchronization and/or midambles and/or spread-spectrum codes (c) used by the base station (BS).

6. The method as claimed in claim 4, characterized in that the further information relates to information on the configuration of a control channel (BCCH).

7. The method as claimed in claim 6, characterized in that the information on configuration relates to a variable number of time slots and/or spread-spectrum codes.

8. The method as claimed in one of claims 4 to 7, characterized in that the coding of the further information extends over a number of time slots (ts) due to the choice and/or sequence of synchronization sequences (cp, cs).

9. The method as claimed in one of the preceding claims, characterized in that the synchronization sequences (cp, cs) are unmodulated orthogonal gold codes.

10. The method as claimed in one of the preceding claims, characterized in that the time slots (ts) are a part of a TDD transmission arrangement with broadband channels, a number of time slots (ts) per frame (fr) being used for the synchronization.

11. The method as claimed in one of the preceding claims, characterized in that the synchronization sequences (cp, cs) are transmitted in time slots (ts) in which information of a control channel (BCCH) is additionally transmitted.

12. The method as claimed in one of the preceding claims, characterized in that the synchronization sequences (cp, cs) are transmitted at lower power compared with other transmissions of the base station (BS).

13. A radio communication system
comprising a number of base stations (BS) for transmitting at least one synchronization sequence (cp, cs),
comprising a controller (RNM) which assigns a time slot (ts) and a different time offset (toff) with respect to the beginning of the time slot (ts) for transmitting the synchronization sequence (cp, cs) to adjacent base stations, the time offset (toff) corresponding to the choice of one of more synchronization sequences (cp, cs) and/or the sequence of a number of synchronization sequences (cp, cs),
comprising a subscriber station (MS) for receiving and evaluating the synchronization sequence (cp, cs),
comprising synchronization means (SYNC) allocated to the subscriber station, which perform a time synchronization by means of the time of reception of the synchronization sequence (cp, cs) and the detected synchronization sequence (cp, cs) designating the time offset (toff) and/or the detected sequence of a number of synchronization sequences (cp, cs).

Abstract

Method and radio communication system for synchronizing subscriber stations

According to the invention, a time slot is assigned to a number of base stations for transmitting at least one synchronization sequence and adjacent base stations use a different time offset with respect to the beginning of the time slot for transmitting the synchronization sequence. Thus, superposition can be precluded even in the case of a synchronized operation of the base stations. So that the subscriber station can still determine the beginning of the time slot, the time offset is transmitted. The time offset corresponds to the choice of one or more synchronization sequences and/or the sequence of a number of synchronization sequences. The information relating to the time offset is transmitted coded in this manner. A subscriber station receives the synchronization sequence and performs a time synchronization by means of the time of reception of the synchronization sequence and the detected synchronization sequence designating the time offset and/or the detected sequence of a number of synchronization sequences.

Figure 3

Fig. 1

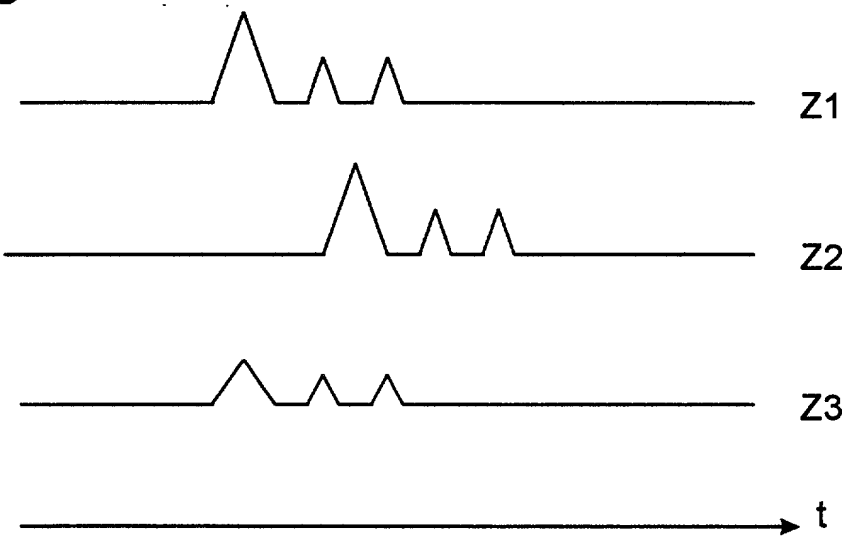


Fig. 3

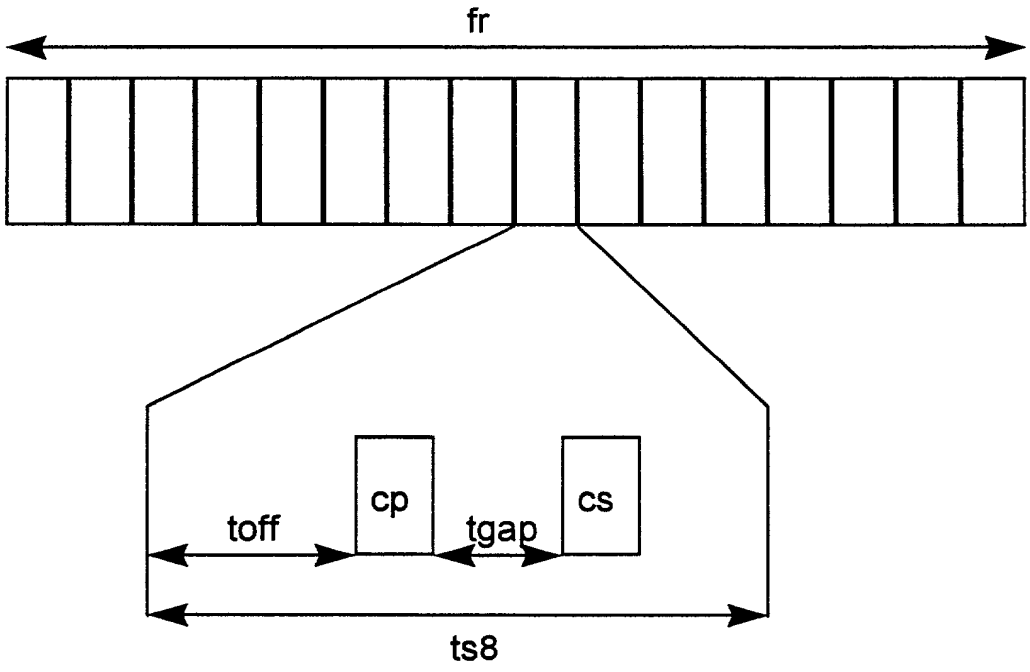


Fig. 2

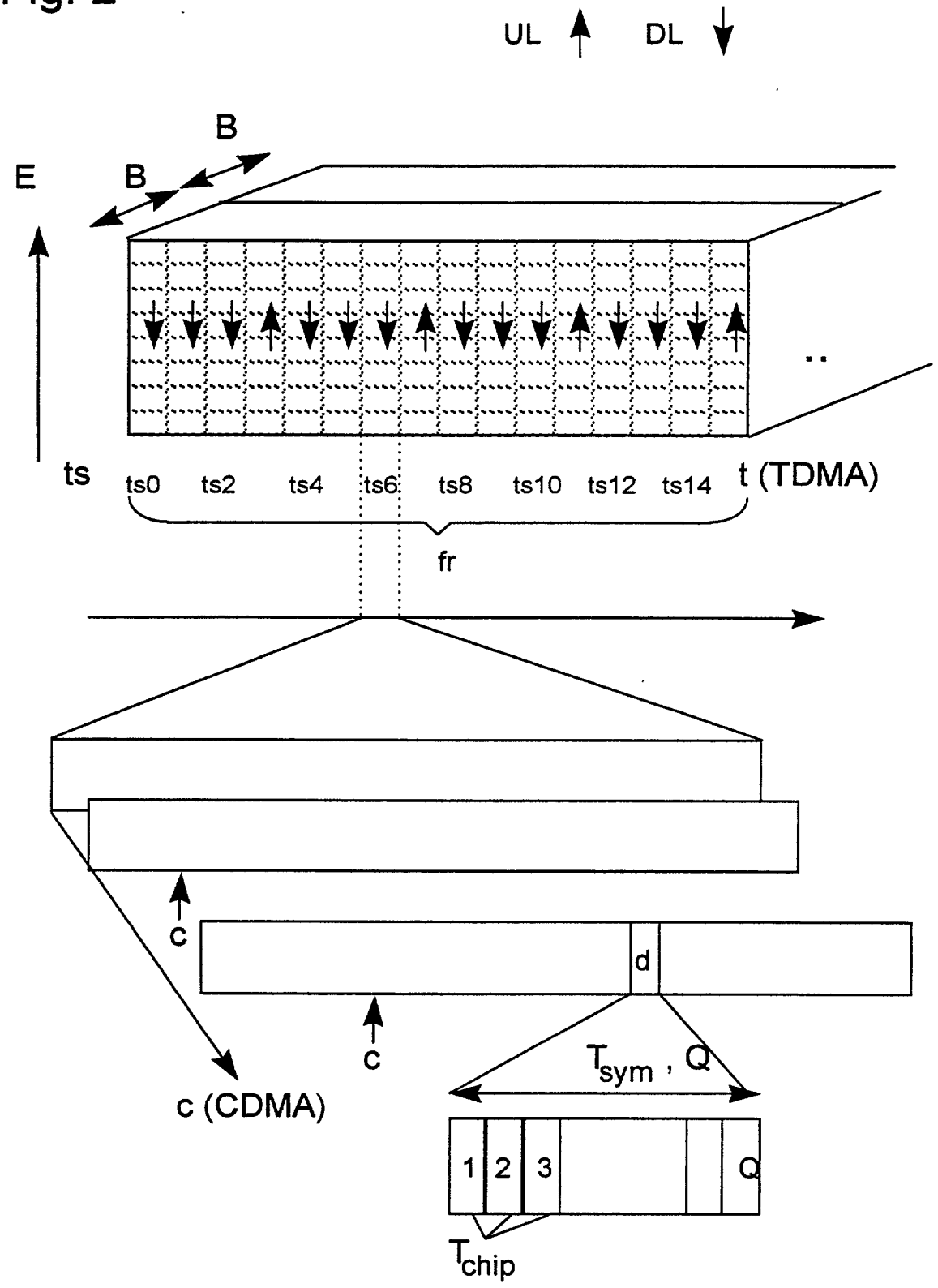

UL
DL
B
E
B
ts
ts0
ts2
ts4
ts6
ts8
ts10
ts12
ts14
t (TDMA)
fr
c
d
c
c (CDMA)
T_{sym} , Q
1
2
3
Q
T_{chip}

Fig. 4

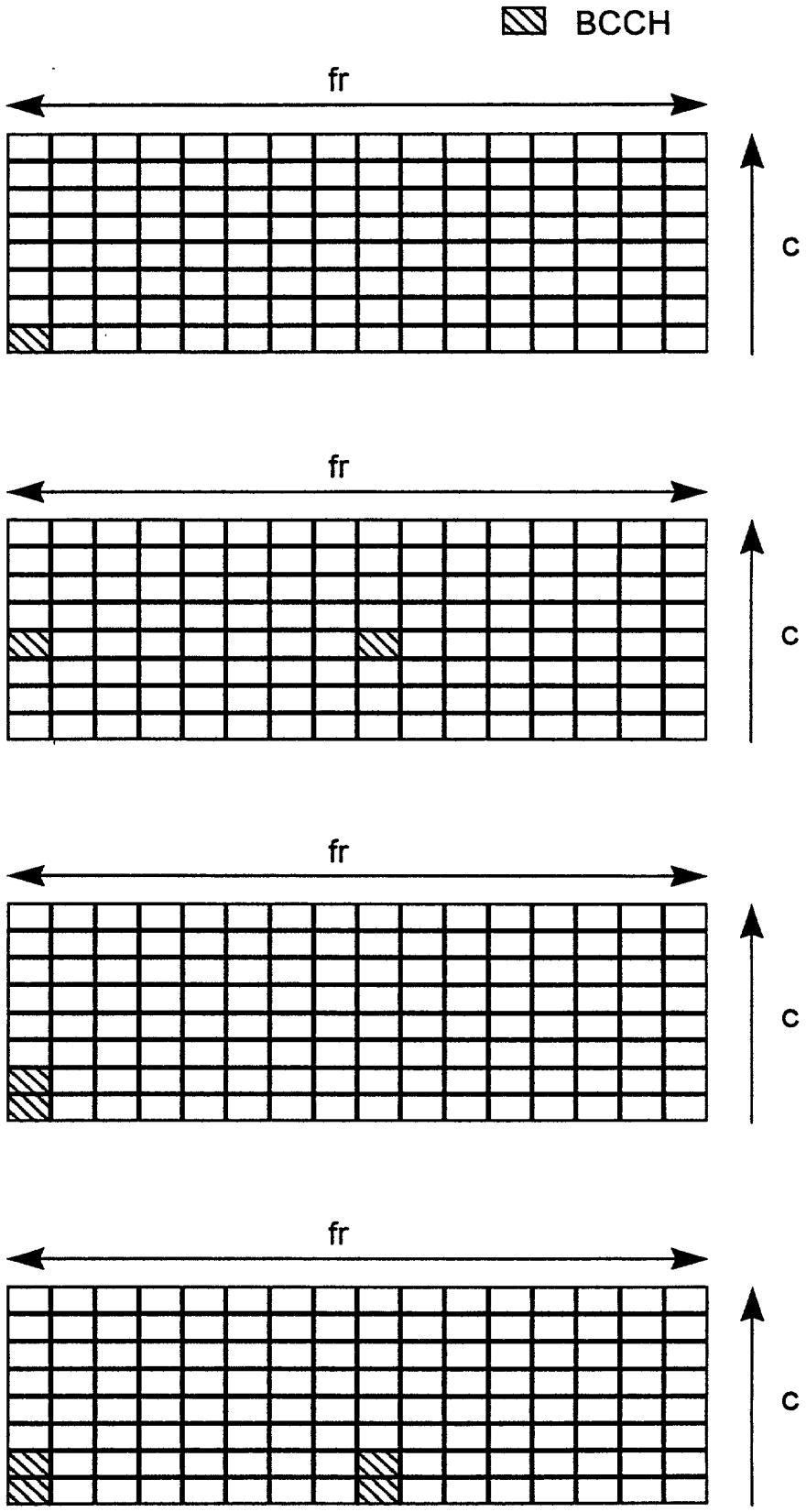
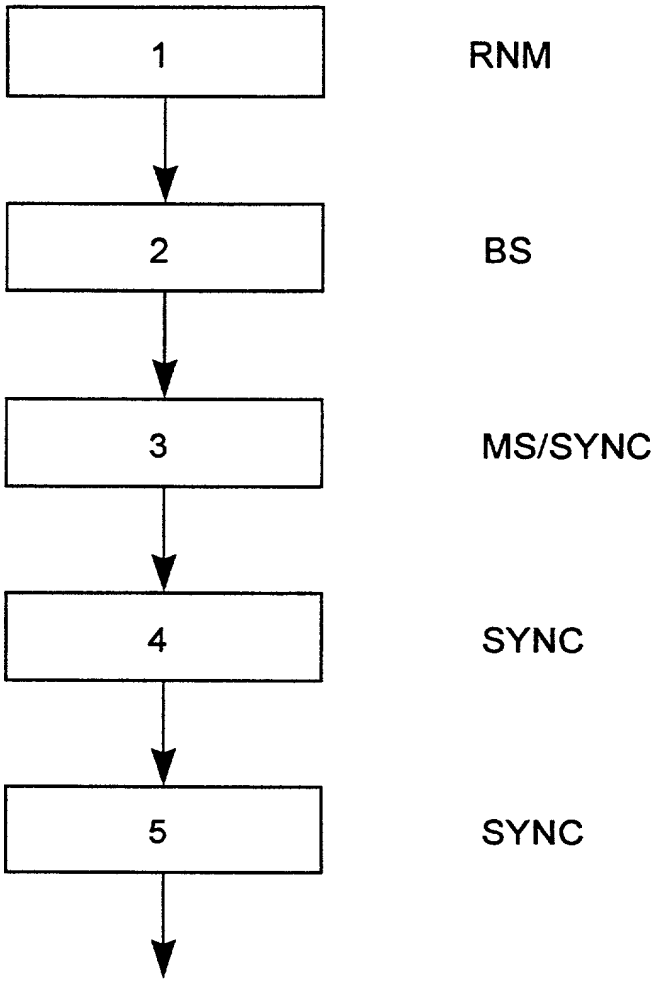


Fig. 5



COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications) PCT/DE99/02805	ATTORNEY'S DOCKET NUMBER 112740-164

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND RADIO COMMUNICATION SYSTEM FOR SYNCHRONIZING SUBSCRIBER STATIONS

the specification of which (check only one item below):

☐ is attached hereto.

■ was filed as United States application
Serial No. 09/786,608
on March 5, 2001
and was amended
on _____(if applicable).

☐ was filed as PCT international application
Number _____
on _____
and was amended under PCT Article 19
on _____(if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to the examination of this application in accordance with Title 37, Code of Federal Regulations, §1.56(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §119 of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Germany	198 40 232.5	03 September 1998	■ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications) PCT/DE99/02805

ATTORNEY'S DOCKET NO. 112740-164

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject mater of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, Untied States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.

PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (If any)			

POWER OF ATTORNEY: As named inventor, I hereby appoint the following attorney(s): Holby M. Abern (P47,372), Robert M. Barrett (30,142), Alan L. Barry (30,819), Thomas C. Basso (46,541), Jeffrey H. Canfield (38,404), Robert W. Connors (46,639), Amy J. Gast (41,773), Timothy L. Harney (38,174), Patricia A. Kane (46,446), Michael S. Leonard (37,557), Edward A. Lehman (22,312), Adam H. Masia (35,602), Dante J. Picciano (33,543), Renato L. Smith (45,117), Maurice E. Teixeira (45,646), William E. Vaughan (39,056), Austin Victor (47,154), and all members of the firm of Bell, Boyd & Lloyd LLC.

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Chicago, Illinois 60690

Direct Telephone Calls to: 312/807-4292

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	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Schukertdamm 328	CITY: 13629 Berlin	STATE & ZIP CODE/COUNTRY: Germany
202	FULL NAME OF INVENTOR	FAMILY NAME: KLEIN	FIRST GIVEN NAME: ANJA	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY: 10709 Berlin DEX	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Paderborner Str. 8	CITY: 10709 Berlin	STATE & ZIP CODE/COUNTRY: Germany
203	FULL NAME OF INVENTOR	FAMILY NAME: SITTE	FIRST GIVEN NAME: ARMIN	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY: 10405 Berlin DEX	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Prenzlauer Allee 237	CITY: 10405 Berlin	STATE & ZIP CODE/COUNTRY: Germany

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	DATE May 29, 01	DATE June 01 01

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications) PCT/DE99/02805

ATTORNEY'S DOCKET NO. 112740-154

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT International application(s) designating the United States of America that is/are listed below and, insofar as the subject mater of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) Holby M. Abern (P47,372), Robert M. Barrett (30,142), Alan L. Barry (30,819), Thomas C. Basso (46,541), Jeffrey H. Canfield (38,404), Robert W. Connors (46,639), Amy J. Gast (41,773), Timothy L. Harney (38,174), Patricia A. Kane (46,446), Michael S. Leonard (37,557), Edward A. Lehman (22,312), Adam H. Masia (35,602), Dante J. Picciano (33,543), Renato L. Smith (45,117), Maurice E. Teixeira (45,646), William E. Vaughan (39,056), Austin Victor (47,154), and all members of the firm of Bell, Boyd & Lloyd LLC.

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P.O. Box 1135
Chicago, Illinois 60690

Direct Telephone Calls to: 312/807-4292

204	FULL NAME OF INVENTOR	FAMILY NAME: ULRICH	FIRST GIVEN NAME: THOMAS	SECOND GIVEN NAME:
	RESIDENCE & CITIZENSHIP	CITY: 13505 Berlin DEX	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Sandhauser Str. 109B	CITY: 13505 Berlin	STATE & ZIP CODE/COUNTRY: Germany
205	FULL NAME OF INVENTOR	FAMILY NAME: FAERBER	FIRST GIVEN NAME: MICHAEL	SECOND GIVEN NAME:
	RESIDENCE & CITIZENSHIP	CITY: 82515 Wolfratshausen DEX	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Schiessstaettstr. 12A	CITY: 82515 Wolfratshausen	STATE & ZIP CODE/COUNTRY: Germany
206	FULL NAME OF INVENTOR	FAMILY NAME: KOTTKAMP	FIRST GIVEN NAME: MEIK	SECOND GIVEN NAME:
	RESIDENCE & CITIZENSHIP	CITY: 10585 Berlin DEX	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Schustehrusstr. 42	CITY: 10585 Berlin	STATE & ZIP CODE/COUNTRY: Germany

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
		Meik Kottkamp
DATE 07 June 2001	DATE	DATE 05/06/01

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications) PCT/DE99/02805	ATTORNEY'S DOCKET NO. 112740-164

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject meter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			

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Direct Telephone Calls to:
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207	FULL NAME OF INVENTOR	FAMILY NAME: SOMMER	FIRST GIVEN NAME: VOLKER	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY: 13503 Berlin DEX	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Schwabstedter Weg 6	CITY: 13503 Berlin	STATE & ZIP CODE/COUNTRY: Germany
208	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY: Germany
209	FULL NAME OF INVENTOR	FAMILY NAME	FIRST GIVEN NAME	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY	STATE OR FOREIGN COUNTRY	COUNTRY OF CITIZENSHIP
	POST OFFICE ADDRESS	POST OFFICE ADDRESS	CITY	STATE & ZIP CODE/COUNTRY

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SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 07.06.01	DATE	DATE

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY (Includes Reference to PCT International Applications) PCT/DE99/02805	ATTORNEY'S DOCKET NUMBER 112740-164

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name, I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

METHOD AND RADIO COMMUNICATION SYSTEM FOR SYNCHRONIZING SUBSCRIBER STATIONS

the specification of which (check only one item below):

☐ is attached hereto.

■ was filed as United States application
Serial No. 09/786,608

on March 5, 2001

and was amended

on _____(if applicable).

☐ was filed as PCT international application

Number _____

on _____

and was amended under PCT Article 19

on _____(if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

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PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. 119:

COUNTRY (if PCT indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 USC 119
Germany	198 40 232.5	03 September 1998	■ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO
			☐ YES ☐ NO

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications) PCT/DE99/02805	ATTORNEY'S DOCKET NO. 112740-164

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject mater of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, Untied States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			

POWER OF ATTORNEY: As named inventor, I hereby appoint the following attorney(s): Holby M. Abern (P47,372), Robert M. Barrett (30,142), Alan L. Barry (30,819), Thomas C. Basso (46,541), Jeffrey H. Canfield (38,404), Robert W. Connors (46,639), Amy J. Gast (41,773), Timothy L. Harney (38,174). Patricia A. Kane (46,446), Michael S. Leonard (37,557), Edward A. Lehman (22,312), Adam H. Masia (35,602), Dante J. Picciano (33,543), Renato L. Smith (45,117), Maurice E. Teixeira (45,646), William E. Vaughan (39,056), Austin Victor (47,154), and all members of the firm of Bell, Boyd & Lloyd LLC.

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Chicago, Illinois 60690

Direct Telephone Calls to:
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201	FULL NAME OF INVENTOR	FAMILY NAME: BENZ	FIRST GIVEN NAME: MICHAEL	SECOND GIVEN NAME:
	RESIDENCE & CITIZENSHIP	CITY: 13629 Berlin	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Schukertdamm 328	CITY: 13629 Berlin	STATE & ZIP CODE/COUNTRY: Germany
202	FULL NAME OF INVENTOR	FAMILY NAME: KLEIN	FIRST GIVEN NAME: ANJA	SECOND GIVEN NAME:
	RESIDENCE & CITIZENSHIP	CITY: 10709 Berlin	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Paderborner Str. 8	CITY: 10709 Berlin	STATE & ZIP CODE/COUNTRY: Germany
203	FULL NAME OF INVENTOR	FAMILY NAME: SITTE	FIRST GIVEN NAME: ARMIN	SECOND GIVEN NAME:
	RESIDENCE & CITIZENSHIP	CITY: 10405 Berlin	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Prenzlauer Allee 237	CITY: 10405 Berlin	STATE & ZIP CODE/COUNTRY: Germany

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SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE 29 May 01	DATE	DATE

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications) PCT/DE99/02605	ATTORNEY'S DOCKET NO. 112740-154

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT International application(s) designating the United States of America that is/are listed below and, insofar as the subject mater of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) Holby M. Abern (P47,372), Robert M. Barrett (30,142), Alan L. Barry (30,819), Thomas C. Basso (46,541), Jeffrey H. Canfield (38,404), Robert W. Connors (46,639), Amy J. Gast (41,773), Timothy L. Harney (38,174), Patricia A. Kane (46,446), Michael S. Leonard (37,557), Edward A. Lehman (22,312), Adam H. Masia (35,602), Dante J. Picciano (33,543), Renato L. Smith (45,117), Maurice E. Teixeira (45,646), William E. Vaughan (39,056), Austin Victor (47,154), and all members of the firm of Bell, Boyd & Lloyd LLC.

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Direct Telephone Calls to:
312/807-4292

204	FULL NAME OF INVENTOR	FAMILY NAME: ULRICH	FIRST GIVEN NAME: THOMAS	SECOND GIVEN NAME
	RESIDENCE & CITIZENSHIP	CITY: 13505 Berlin	STATE OR FOREIGN COUNTRY: Germany	COUNTRY OF CITIZENSHIP: Germany
	POST OFFICE ADDRESS	POST OFFICE ADDRESS: Sandhauser Str. 109B	CITY: 13505 Berlin	STATE & ZIP CODE/COUNTRY: Germany
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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 204	SIGNATURE OF INVENTOR 205	SIGNATURE OF INVENTOR 206
DATE	DATE 6.6.01	DATE 11/06/01

Combined Declaration For Patent Application and Power of Attorney (Continued) (Includes Reference to PCT International Applications) PCT/DE99/02805	ATTORNEY'S DOCKET NO. 112740-164

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s) or PCT international application(s) designating the United States of America that is/are listed below and, insofar as the subject meter of each of the claims of this application is not disclosed in that/those prior application(s) in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose material information as defined in Title 37, Code of Federal Regulations, §1.56(a) which occurred between the filing date of the prior application(s) and the national or PCT international filing date of this application:

PRIOR U.S. APPLICATIONS OR PCT INTERNATIONAL APPLICATIONS DESIGNATING THE U.S. FOR BENEFIT UNDER 35 U.S.C. 120:

U.S. APPLICATIONS		STATUS (Check one)		
U.S. APPLICATION NUMBER	U.S. FILING DATE	PATENTED	PENDING	ABANDONED

PCT APPLICATIONS DESIGNATING THE U.S.					
PCT APPLICATION NO	PCT FILING DATE	U.S. SERIAL NUMBERS ASSIGNED (if any)			

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following attorney(s) Holby M. Abern (P47,372), Robert M. Barrett (30,142), Alan L. Barry (30,819), Thomas C. Basso (46,541), Jeffrey H. Canfield (38,404), Robert W. Connors (46,639), Amy J. Gast (41,773), Timothy L. Harney (38,174), Patricia A. Kane (48,446), Michael S. Leonard (37,557), Edward A. Lehman (22,312), Adam H. Masia (35,602), Dante J. Picciano (33,543), Renato L. Smith (45,117), Maurice E. Teixeira (45,646), William E. Vaughan (39,056), Austin Victor (47,154), and all members of the firm of Bell, Boyd & Lloyd LLC.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

SIGNATURE OF INVENTOR 201	SIGNATURE OF INVENTOR 202	SIGNATURE OF INVENTOR 203
DATE	DATE	DATE